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Geokon Model 6850 2D Pendulum Operation Notes

Sensor Application Note #16

Overview

This Sensor Application Note will provide information to help integrate the Geokon Model 6850 Pendulum into a Campbell CR800 or CR1000 based monitoring system when configured using MultiLogger.

It will include wiring details as well as programming details to deploy this equipment.

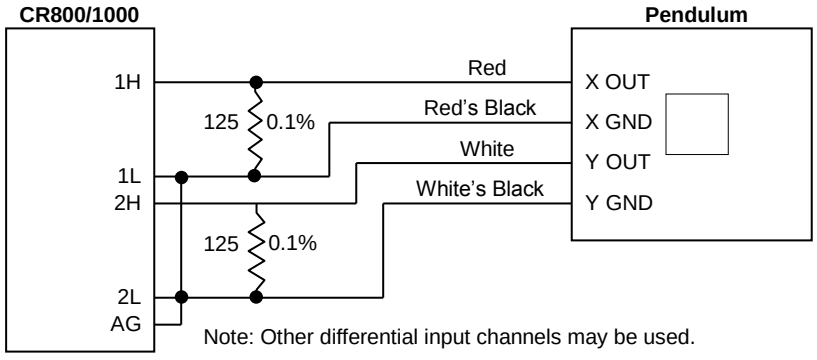
The Model 6850 Pendulum includes an RS-485 (half-duplex) interface as well as dual 4-20mA outputs.

Wiring

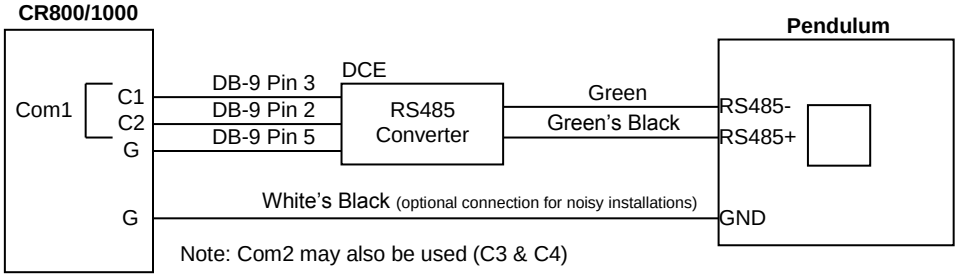
Below is the connector pinout for the Geopendulum. The connector is located on the underside of the unit next to the power cord gland.

Pin	Description	Color (Pre-assembled)
A	X-Axis 4-20mA Output	Red
B	Ground	Red's Black
C	Y-Axis 4-20mA Output	White
D	Ground	White's Black
E	No Connection	
F	RS-485-	Green
G	RS-485+	Green's Black
H,J,K	No Connection	

4-20mA Connection



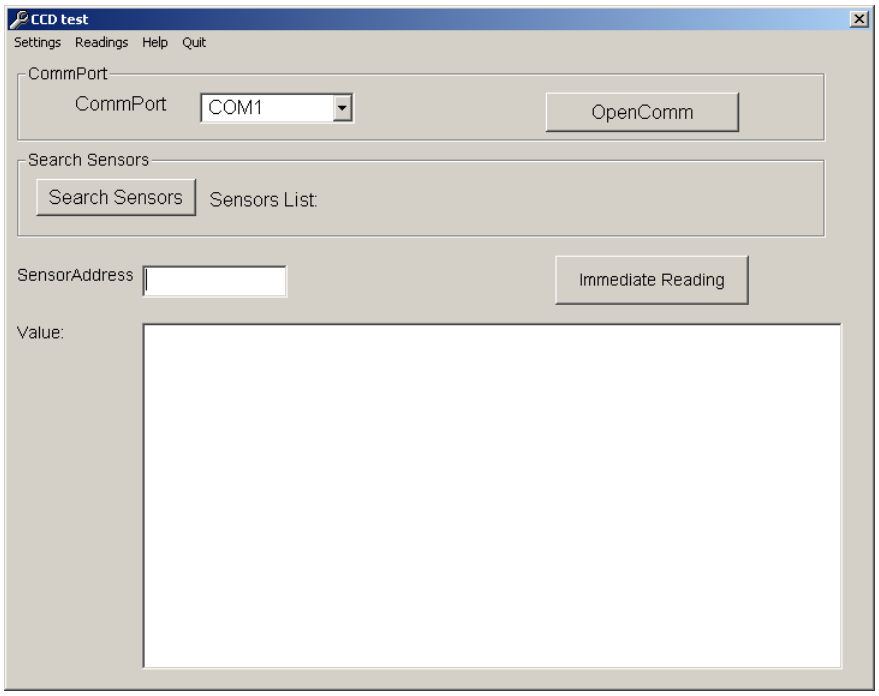
RS-485 Connection



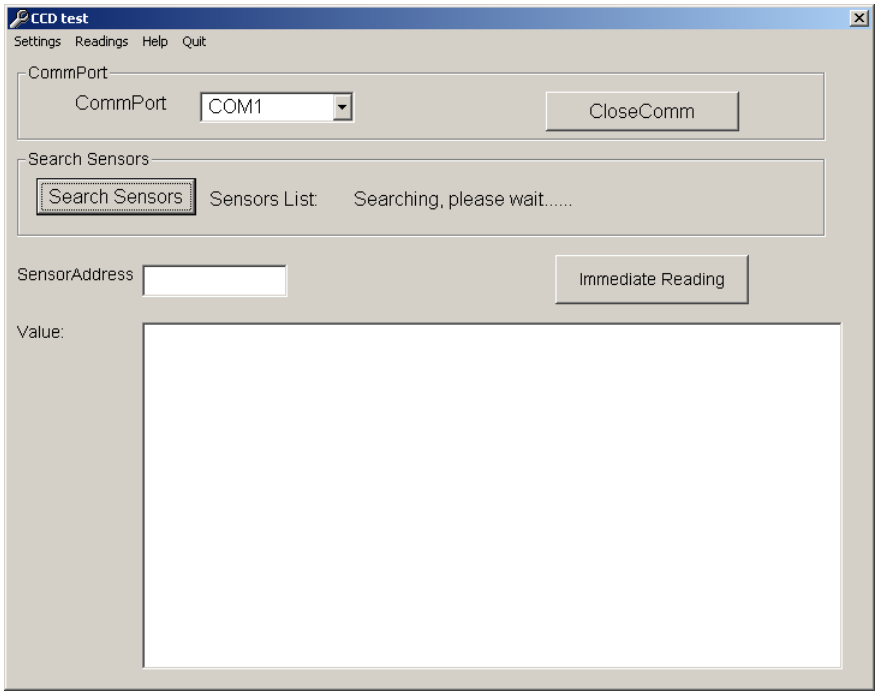
Pendulum Configuration

The pendulum comes equipped with **CCDTest** software which is used for setting the pendulum parameters and checking the operation of the unit. Use the supplied installer to install the software. When starting the software you will see an interface as below.

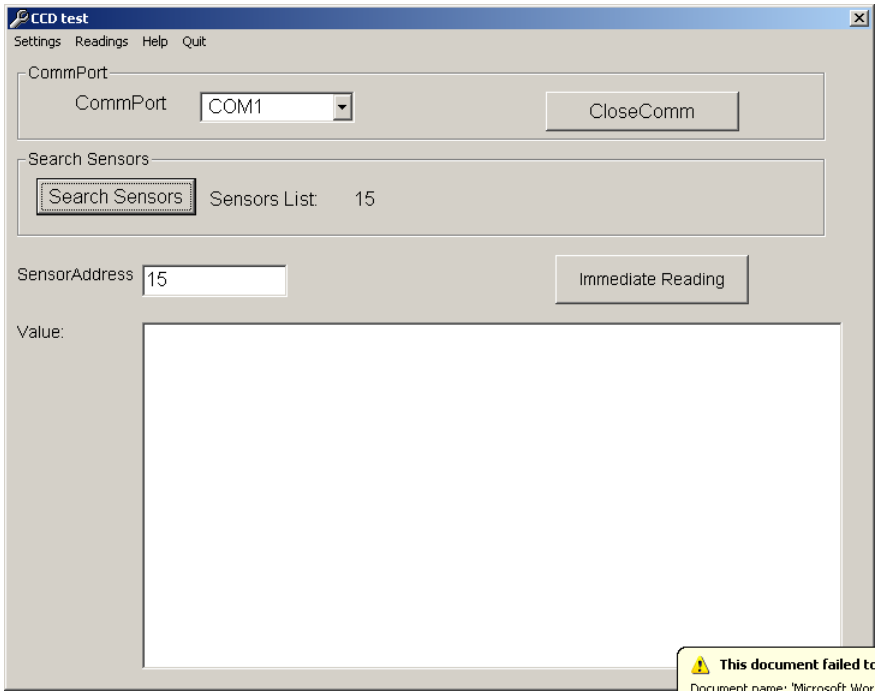
Configure the **CommPort** which has the RS-485 adaptor attached, then click **OpenComm**.



If you aren't sure of the pendulums address then click the **Search Sensors** button to have the software try and locate them for you.

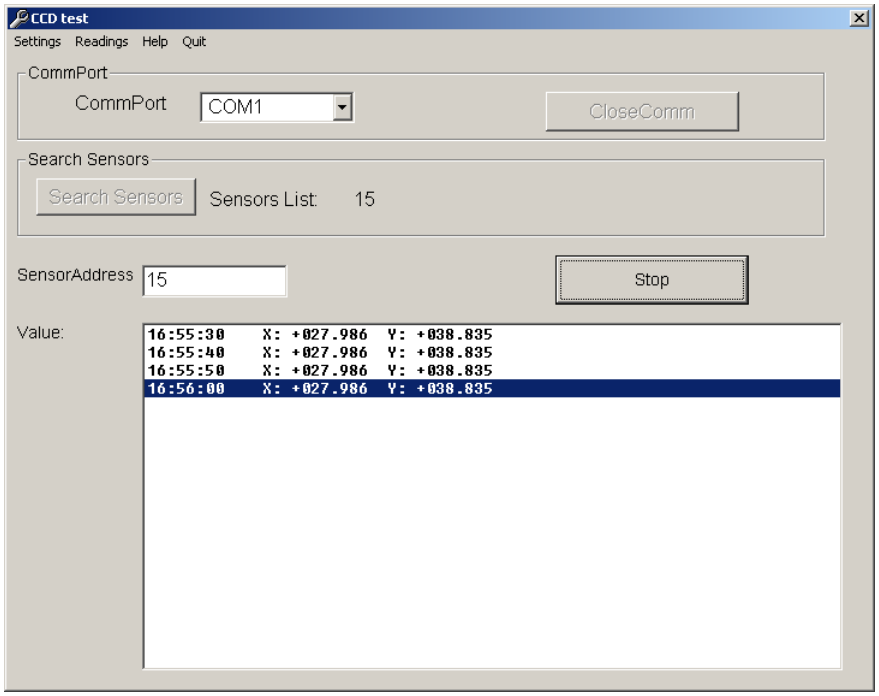


Sensors found will be shown in the **Sensors List**. Enter the Sensor Address you wish to communicate with in the **SensorAddress** edit, the example below shows address 15 was found and entered in the **SensorAddress** edit.

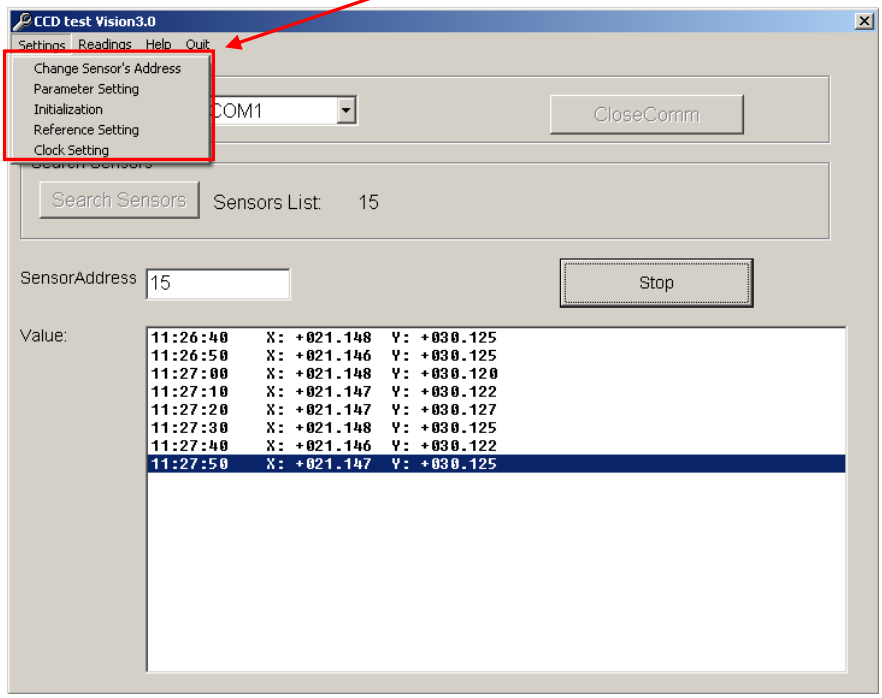


Click **Immediate Reading** to take measurements every 10 seconds from the attached pendulum.

The measurements will display in the Value edit with time stamp and X and Y values. Note any errors shown and troubleshoot if necessary. See the later section for an explanation of the error codes.

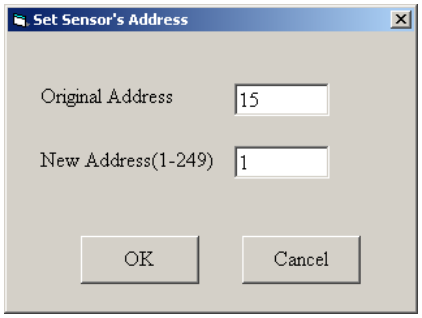


The CCDTest software provides several functions related to the configuration of the pendulum, in particular the setting of the Address, the wire configuration, the setting of the Reference values, the setting of the Clock and the orientation of the outputs. These options are available from the **Settings** menu in the upper left portion of the form.

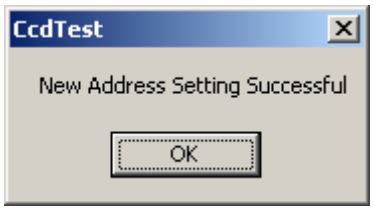


Set Sensor Address

Use the **Change Sensor's Address** option from the menu – the Set Sensor's Address form will display.

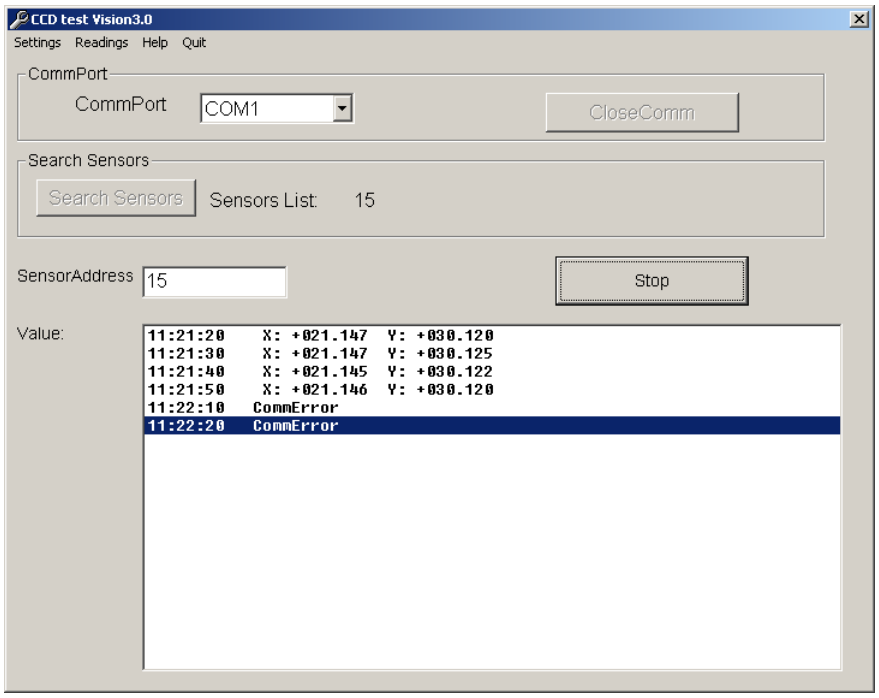


Enter the **Original Address** in the edit, followed by the **New Address**. Click **OK** when finished. The software will attempt to set the address and will show a status message. If it fails try again.

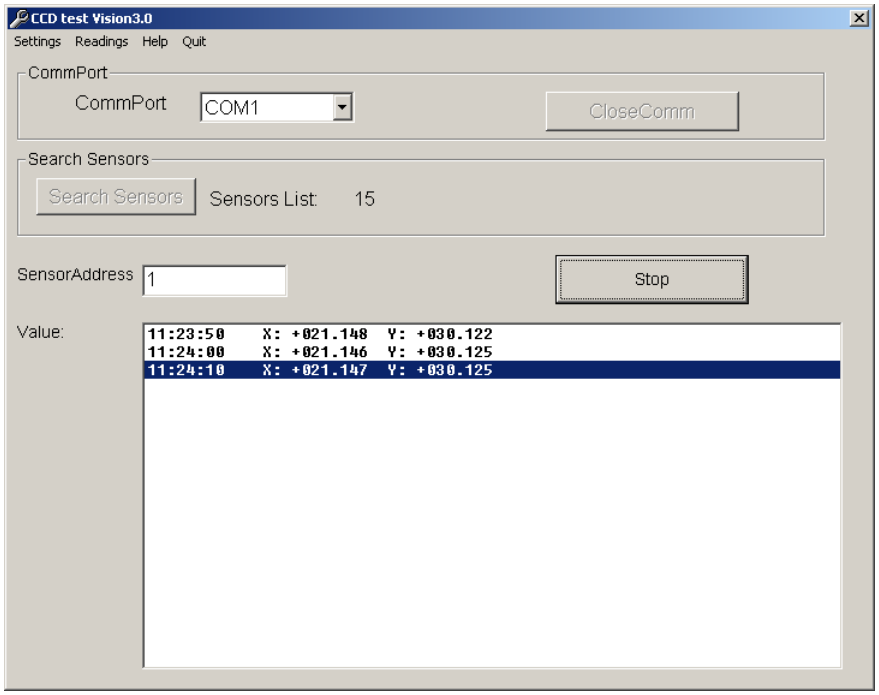


Once successful then click **OK** and then **Cancel** at the Set Sensor's Address form to return to the main form.

Note that once the address is changed you will need to update the **SensorAddress** edit with the new address. A **CommError** will display until you update the address, example shown below.



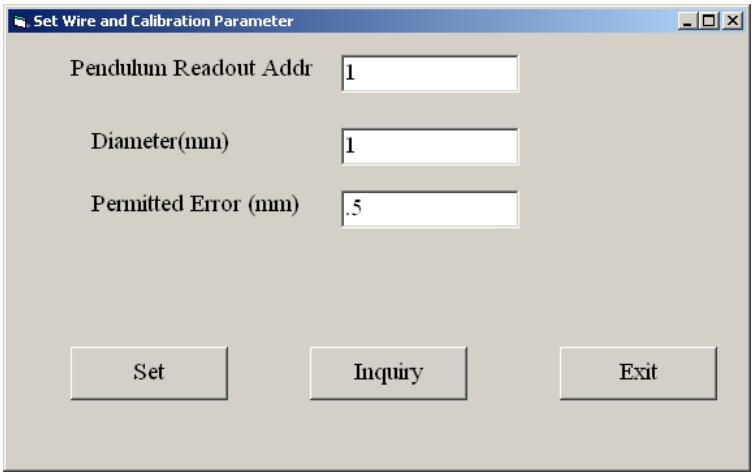
Once the **Sensor Address** is updated the readings should display properly again.



Note: The Value display will clear after stopping and re-starting the Immediate Reading function.

Set Wire and Calibration Parameter

Use the **Parameter Setting** menu item to configure the wire diameter and error band.



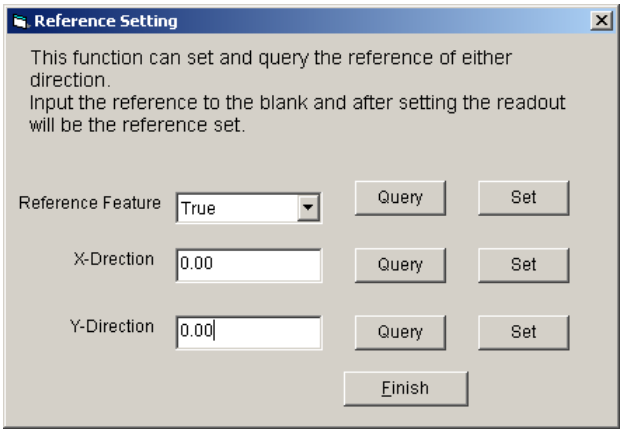
Configure the Sensor address to adjust, then enter the wire **Diameter** in millimeters and the **Permitted Error** in millimeters. The Permitted Error is usually entered as 0.5mm, shown above. Click **Set** to adjust the internal pendulum settings, you can also use the **Inquiry** button to check the current pendulum settings. Click **Exit** when finished to return to the main form.

Set Reference Setting

The Reference feature allows adjusting the output of the unit for a given value. This is often used to maintain contiguous data when replacing units in service or moving the units for regular cleaning or other maintenance. Without the Reference feature then the values must be adjusted during post-processing to account for differences in measurements after moving or replacing a unit.

Note: You must have the pendulum address entered in the SensorAddress edit on the main form for these options to work correctly!

Use the **Reference Setting** menu item to display the Reference Setting form.

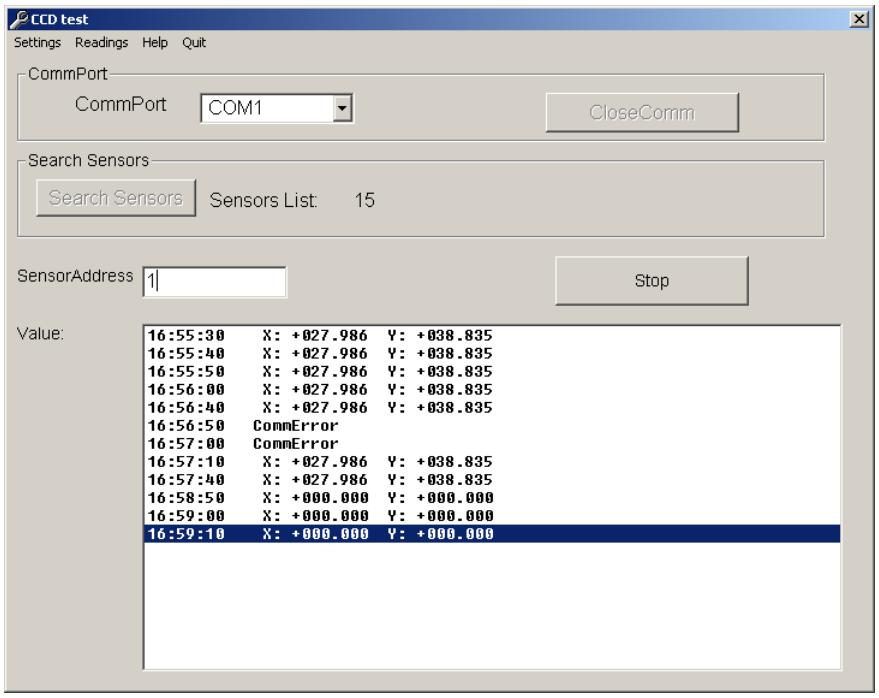


In the example shown the pendulum will be configured to show change in movement after installation. Enter 0.00 for the **X-Direction** and press **Set** to set this value as the X-axis Reference. The software should provide a message indicating successful Reference setting, along with the internal offset (the current absolute measurement) to adjust the output to achieve the desired Reference output.

Enter 0.00 for the **Y-Direction** and press **Set**. AFTER pressing Set for both X and Y-Direction then configure True (default) as the Reference Feature and press **Set**. This will configure the unit to use the new X and Y-direction values as the starting values for the display and the 4-20mA output.

Click **Finish** when Reference Setting changes are complete.

Once the Reference values are set you should see the display on the pendulum update to the new Reference values, close the form by clicking in the upper right corner.



Note when returning to the main form the X and Y values should update to match the display, to show them as Referenced according to the values entered.

Consider this sequence as an example of how the References feature helps maintain contiguous data.

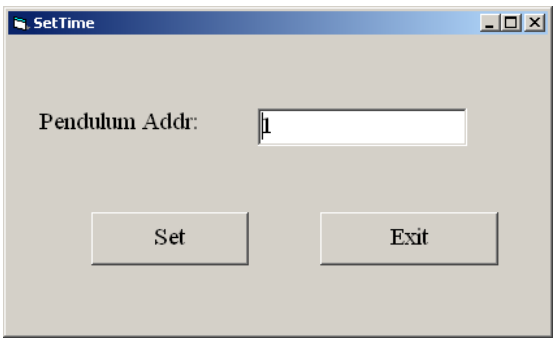
1. The values from the currently installed pendulum are 27.986 and 38.835 millimeters for X and Y respectively. The References feature is NOT being used so these are absolute values.

2. The unit is removed, cleaned and re-installed. The new readings are 25.456 and 31.894 for X and Y respectively.

3. Use the Reference Setting menu item to display the Reference Setting form. Enter 27.986 and 38.835 as the X and Y-direction References respectively. Set **Reference Feature** to True. The display will update to show the measurements last recorded prior to removing the unit. This provides for contiguous data without the need to apply post-processing offset corrections.

Set Time

Use the menu item **Clock Setting** to display the Set Time form. Configure the pendulum address and press **Set** to match the internal pendulum clock to the PC clock.



This is useful when the pendulum is logging readings in its internal memory.

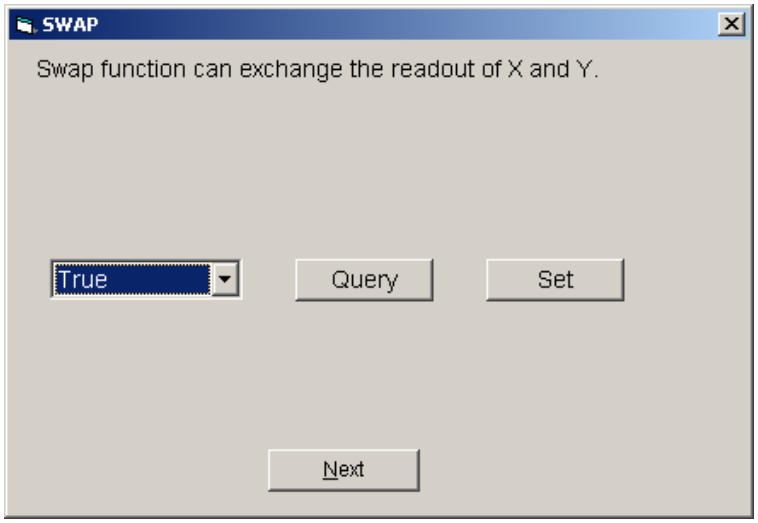
Click **Exit** to return to the main form.

Before using **Quit** to exit the CCDTest software be sure to Stop any automated readings and then use **CloseComm** to close the Comm port.

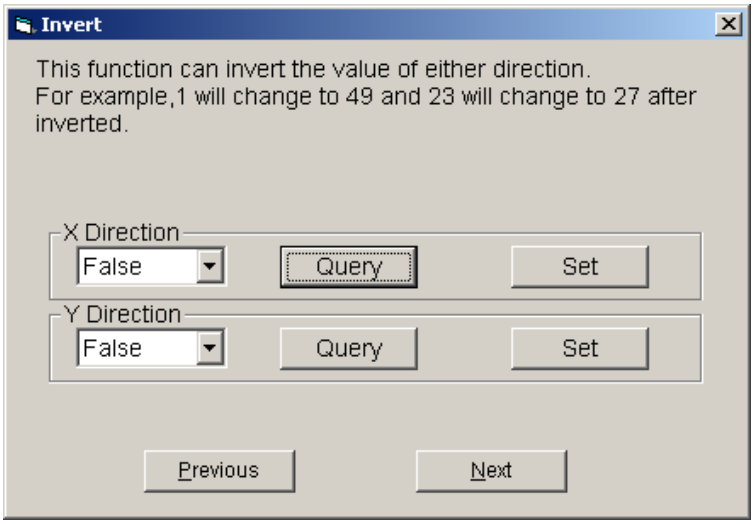
Set Wire and Calibration Parameter

Use the menu item **Initialization** to swap the X and Y axis, this includes reversing the digital display and the 4-20mA outputs of the unit. This menu also provides for reversing the direction of each axis, for example if the X-axis is currently reading 35.78mm it will read 14.22mm if swapped. These features are useful where the installed orientation of the unit must match the direction of anticipated movement.

When selecting the menu item the Swap form will display. The default is False, however it may be changed to True by selecting from the drop-down menu and pressing **Set**. Press **Query** to view the current setting of the pendulum.



Click **Next** to continue to the Invert form. For each axis you may configure reversing the direction of movement. The default is **False**, use the drop-down for each axis to select **True** if needed. Press **Set** to update the pendulum with the setting, press **Query** to view the current settings.



Note: The Invert options will configure the axis as it is currently displayed. In other words if Swap is True then setting X Direction to True will invert the direction of what was originally the Y axis.

When finished press **Next**, this will advance to Reference Setting form, see the previous section for detail on configuring these options. Press **Previous** to return to the Swap form.

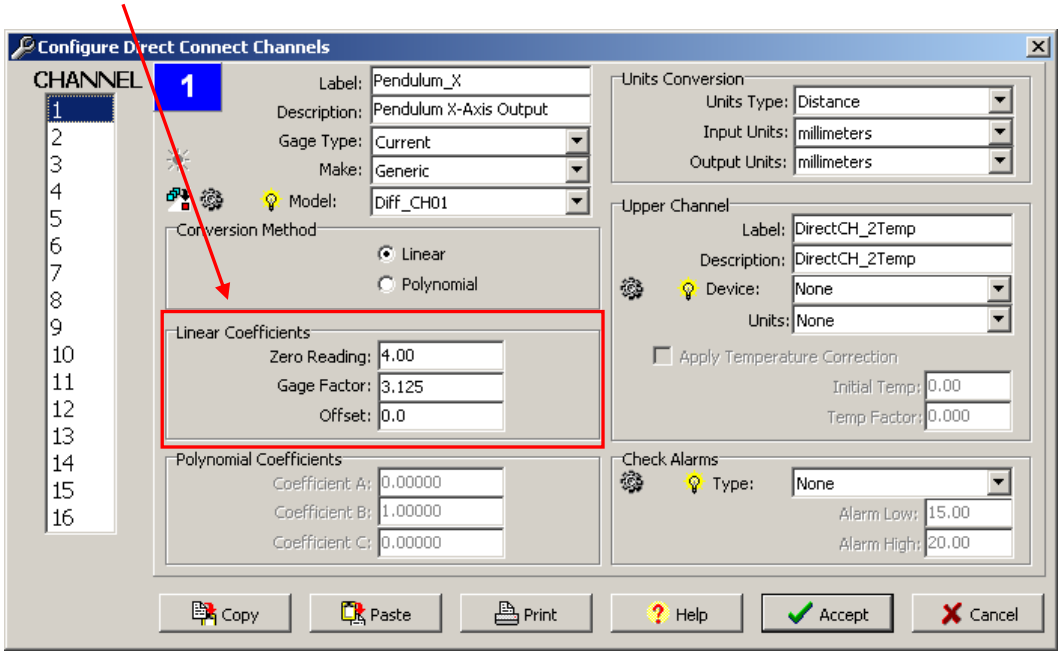
MultiLogger Configuration

The pendulum may be integrated to the Campbell MCU using the 4-20mA output or RS-485. RS-485 is recommended as it eliminates any analog measurement error from the readings.

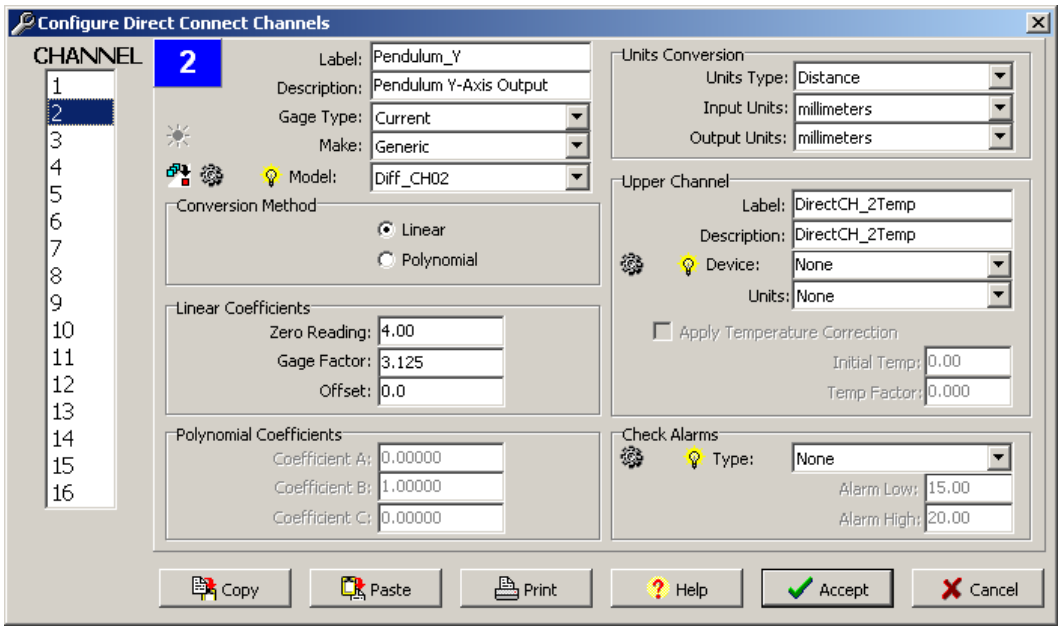
4-20mA Configuration

Direct Connect Channels are used for configuring the Geopendulum measurements. Each channel corresponds to an X or Y-axis measurement – this provides for including the math to convert from mA to millimeters or other units.

Note the **Linear Coefficients** used to convert from current to millimeters.



The Y-axis would be configured as follows:



RS-485 Configuration

Note: Geopendulum RS-485 support is only provided for the CR800and CR1000 control modules. The gage types referenced following are found in MultiLogger version 4.2 or higher. Contact your software vendor or Canary Systems directly to obtain the current version of software.

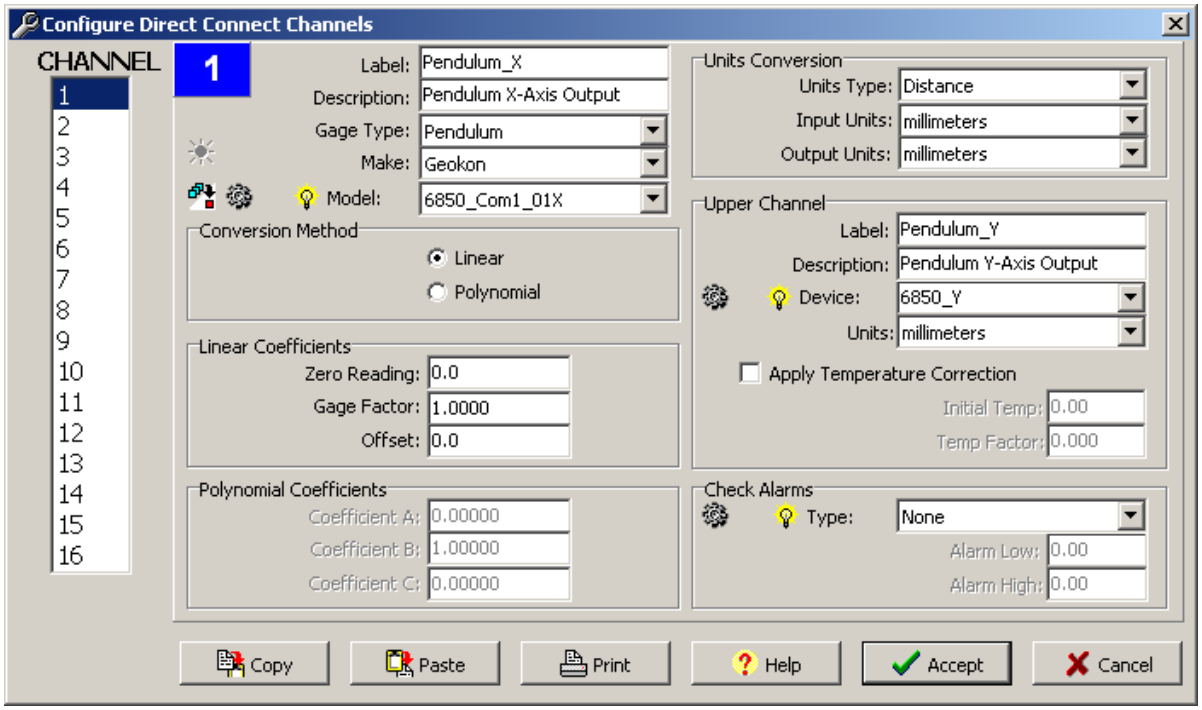
Generally the **Direct Connect Channels** are used for configuring the Geopendulum measurements. There are 2 methods of configuring them, dependent on whether the resultant values must be converted to other units or Alarms must be configured on each measurement.

The output units of the Geopendulum are **millimeters**.

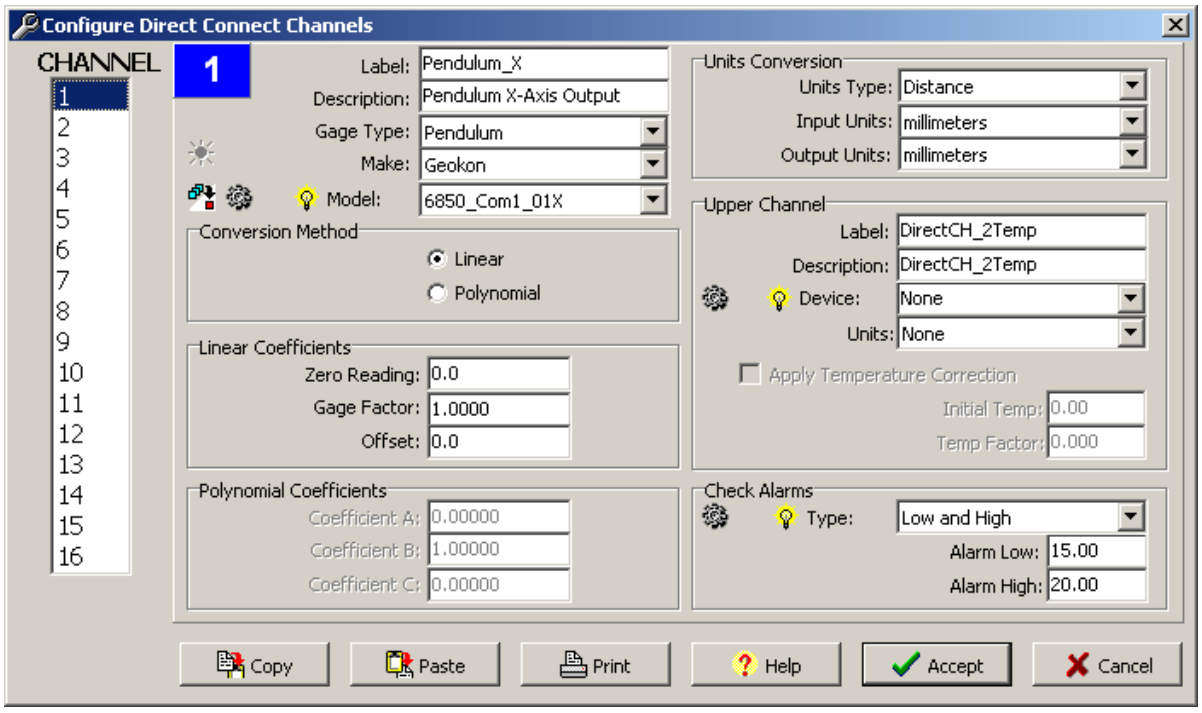
Shown below is a typical channel configuration to read the X and Y-axis outputs of a pendulum connected to Com1 on the control module (Control Ports C1 & C2 used for communications) at address 01. Addresses 1-16 are supported – contact Canary Systems if your application has more than 16 pendulums per network.

Note the availability of gage types for COM1 (Control Ports C1 & C2) and COM2 (Control Ports C3 & C4). The CR800 has 2 COM ports, the CR1000 has 4. Contact Canary Systems if your application requires the use of COM3 (Control Ports C5 & C6) or COM4 (Control Ports C7 & C8) on the CR1000.

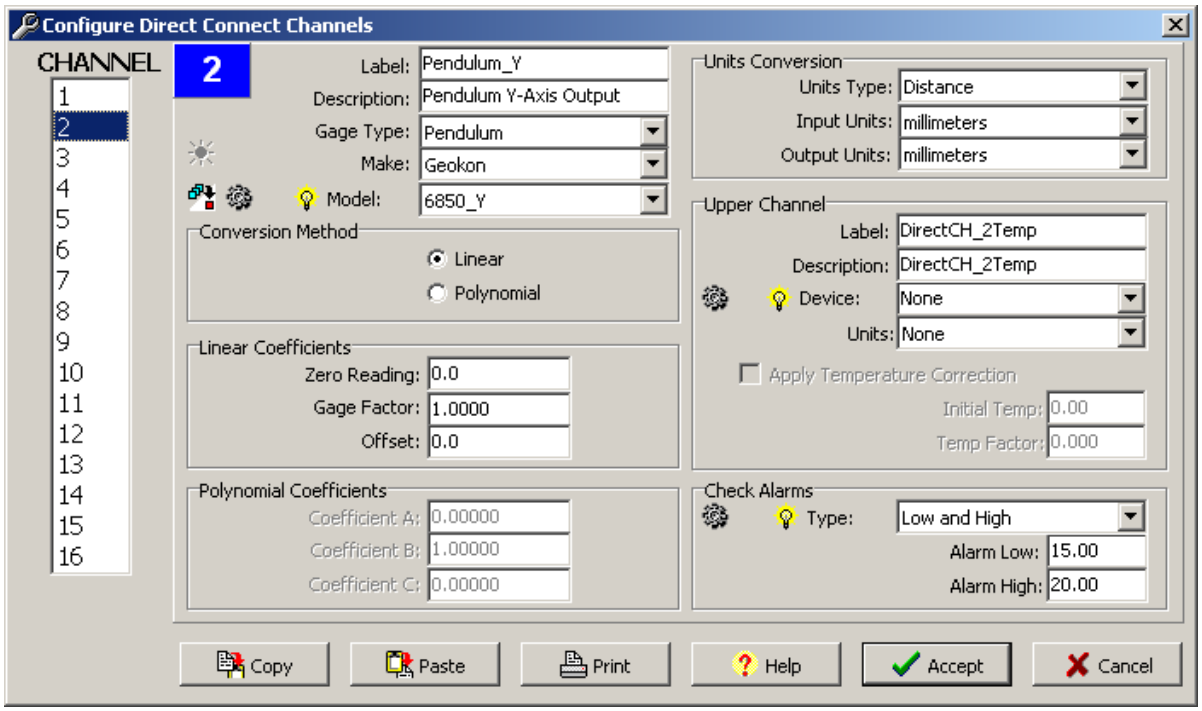
Note that this configuration allows converting the X-axis values using the Conversion Method and/or the Units Conversion, as well as configuration of alarms using the Check Alarms options. You will not be able to make similar adjustments, nor utilize the Check Alarms for the matching Y-axis value.



If your application requires conversions and/or **Check Alarms** settings then you will need to configure the Y-axis as a separate Channel. For example, Channel 1 would be configured as follows:



Channel 2 to support the Y-axis measurement would be configured as follows:



This configuration technique limits the number of pendulums that can be configured to 8.

Error Codes

The Geopendulum has several error codes which indicate problems with the installation or the unit. These codes will be shown on the pendulum display and have equivalent values when automating the systems using MultiLogger. Please consult the Model 6850 Geopendulum Instruction manual for additional troubleshooting information.

Code	MultiLogger Code	Description
Err2	-99992	Ambient light is too bright.
Err3	-99993	Projected light is too weak.
Err4	-99994	Wire is out of range.
Err5	-99995	Fault has occurred in CCD element.
Err6	-99996	Shadows interfering with measurement – usually due to moisture or debris in the light path.
No Display	-99999	Power loss to the unit or communication breakdown.

Pendulum Commands

Terminal emulation programs may be programmed with the pendulum commands to help with troubleshooting and configuration of the units. Below are typical commands and responses. Communication parameters are **9600 bps, 8 data bits, 1 stop bit, no parity bit**. The baud rate of the pendulum is fixed at 9600 bps.

All commands are prefaced with a colon, ":", followed by the address of the unit in hexadecimal notation, the command and any parameters and then terminated with "FF" <CR> <LF>. Responses include a two-byte signature ("gg").

Command	Command	Response
Set Address, where; aa = current address (01-FF) bb = new address (01-FF)	**:aa02bbFF**	:aa02bbFB
Get X & Y Axis readings, where; aa = address s = sign (+/-) xxx.xxx = x-axis yyy.yyy = y-axis gg = signature	**:aa2101FF**	:aa2101sxxx.xxxsyyy.yyy gg
Set X-axis Parameters, where; aa = address ww = wire diameter in mm (2 digits no decimal, e.g. 1.0 mm = 10) ee = error in mm (2 digits no decimal, e.g. 0.5 mm = 05)	**:aa67wwee010000FF**	:aa67wwee010000gg
Set Y-axis Parameters (see above)	**:aa69wwee010000FF**	:aa69wwee010000gg
Query Reference Setting, where; aa = address	**:aa76FF**	:aa76rrgg
Set Reference False	**:aa7500FF**	:aa7500gg
Set Reference True	**:aa7501FF**	:aa7501gg
Set X-Axis Reference, where; aa = address s = sign (+/-) xxx.xxx = x-axis reference value (entered as an offset)	**:aa71sxxx.xxxFF**	:aa71sxxx.xxxgg
Set Y-Axis Reference, where; aa = address s = sign (+/-) yyy.yyy = y-axis reference value (entered as an offset)	**:aa71syyy.yyyFF**	:aa71syyy.yyygg
Read/Set clock, where; aa = address yy = year mm = month dd = day hh = hour mm = minute ss = second	**:aa04FF** **:aa03yymmddhhmmssFF**	:aa04yymmddhhmmssgg :aa03yymmddhhmmssgg

CR800/CR1000 Programming Example **(gt_6850_com1_01x.cr1 instruction file)**

```
'Read the X and Y output of a Geokon Geopendulum connected to COM1 (C1 & C2) at Address 01
'Open our port
SerialOpen (Com1,9600,0,1000,255)

'Clear our counter
ScratchLoc(1) = 0

'Loop 5 times to get measurement
Do
	'Make sure buffer is clear
	SerialFlush(Com1)

	'Send Reading command
	SerialOut (Com1,":012101FF"+CHR(13)+CHR(10),"",0,0)

	'Receive response with .25 second timeout
	SerialIn(sInBuf,Com1,25," ",30)

	'Check for enough characters
	if Len(sInBuf) >= 23 then
		'Split out response values
		Splitstr(ScratchLoc(2),sInBuf,"",3,0)

		'Check for error codes
		if ScratchLoc(3) = 2000000 or ScratchLoc(4) = 2000000 then
			ScratchLoc(3) = -99992
			ScratchLoc(4) = -99992
		endif
		'Check for error code
		if ScratchLoc(3) = 3000000 or ScratchLoc(4) = 3000000 then
			ScratchLoc(3) = -99993
			ScratchLoc(4) = -99993
		endif
		'Check for error code
		if ScratchLoc(3) = 4000000 or ScratchLoc(4) = 4000000 then
			ScratchLoc(3) = -99994
			ScratchLoc(4) = -99994
		endif
		'Check for error code
		if ScratchLoc(3) = 5000000 or ScratchLoc(4) = 5000000 then
			ScratchLoc(3) = -99995
			ScratchLoc(4) = -99995
		endif
		'Check for error code
		if ScratchLoc(3) = 6000000 or ScratchLoc(4) = 6000000 then
			ScratchLoc(3) = -99996
			ScratchLoc(4) = -99996
		endif

	'No valid response
	Else
		ScratchLoc(3) = -99999
		ScratchLoc(4) = -99999
	EndIf

	'Short delay before trying again or exiting
	Delay(0,250,mSec)

	'Increment our counter
	ScratchLoc(1) = ScratchLoc(1) + 1

Loop Until (ScratchLoc(1) >= 5) OR (ScratchLoc(3) > -99990)

'Copy our reading whatever it is (ScratchLoc(4) holds Y-Axis value)
mlReading = ScratchLoc(3)

'Close our serial port
SerialClose (Com1)
```

Firmware Replacement Instructions

Updates to the functionality of the Geopendulum may require replacement of the firmware chips located inside the unit. There are 2 chips that must be replaced, one for each axis.

In order to perform this procedure properly, you will require the following tools:
- 3mm Allen wrench
- 5mm Allen wrench
- #2 Phillips screwdriver
- PLCC (Plastic Leaded Chip Carrier) Chip Extractor Tool

In addition, use a grounding strap to prevent electrostatic damage to the unit and/or replacement chips.

IMPORTANT: Before starting, be aware that the unit should not rest on the power cord or connector underneath it, doing so may damage the cord or connector. It is suggested to place the unit slightly off the edge of a surface to allow those pieces to hang freely and out of the way during maintenance.

1. Using the 5mm Allen wrench, remove the gap bracket from the cover.
2. Using a 3mm Allen wrench, remove all of the remaining screws at the bottom edge of the cover.
3. Remove the cover by lifting it straight up off of the base.
4. Using the Phillips screwdriver, unscrew the 6 screws that secure the lid of the module(s) you wish to access. *(Fig. 1)*

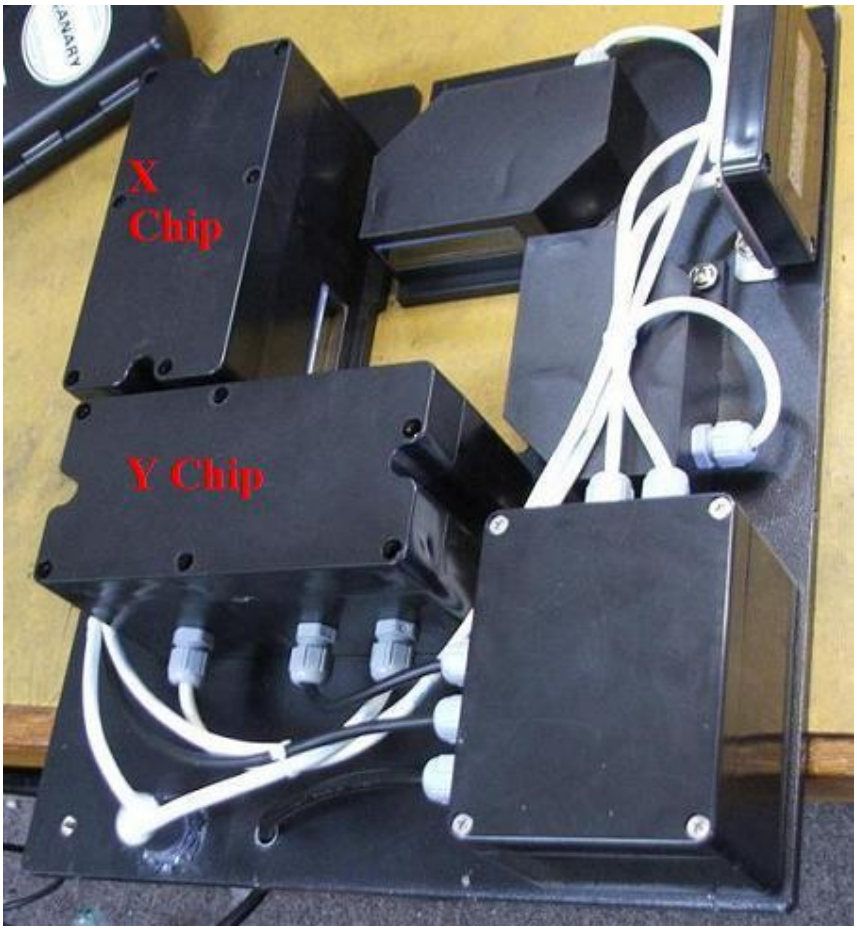


Figure 1: Inner modules containing either the "X" or "Y" microchip

5. Once the lid is removed, carefully slide the axis board up out of the container. The wiring should remain intact *(See Fig. 2 & 3)*

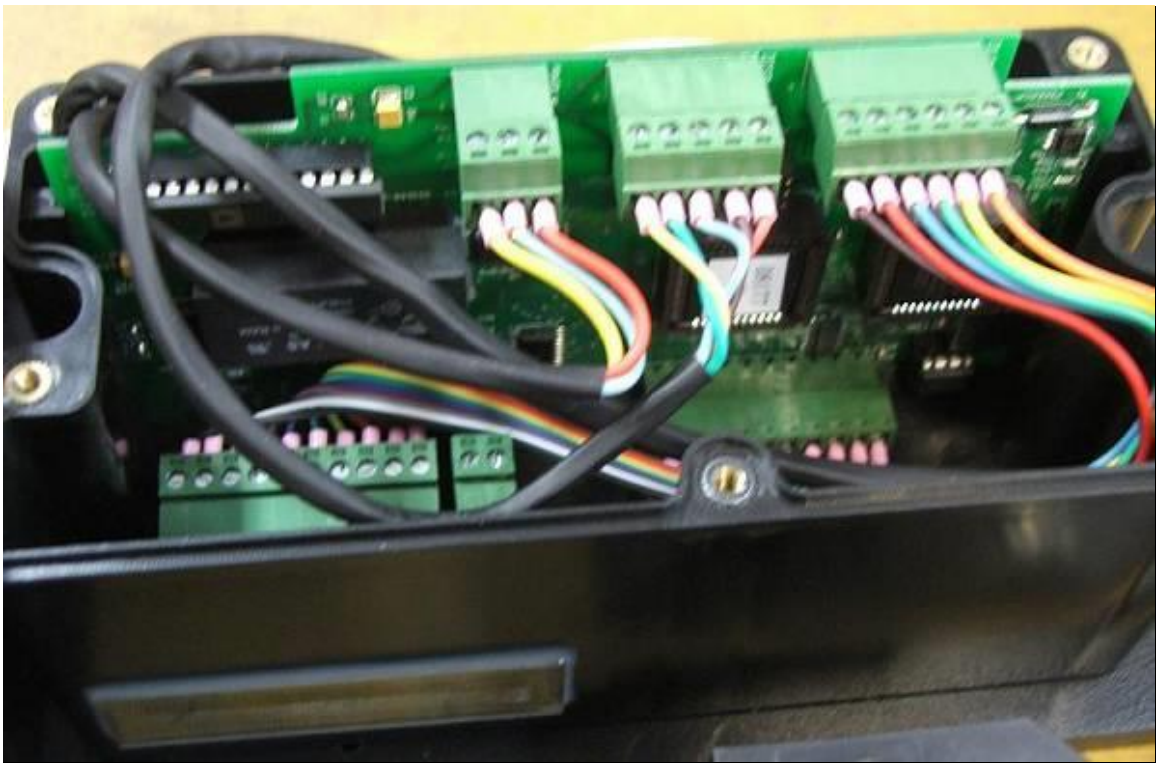


Figure 2: The axis board still inside the enclosure

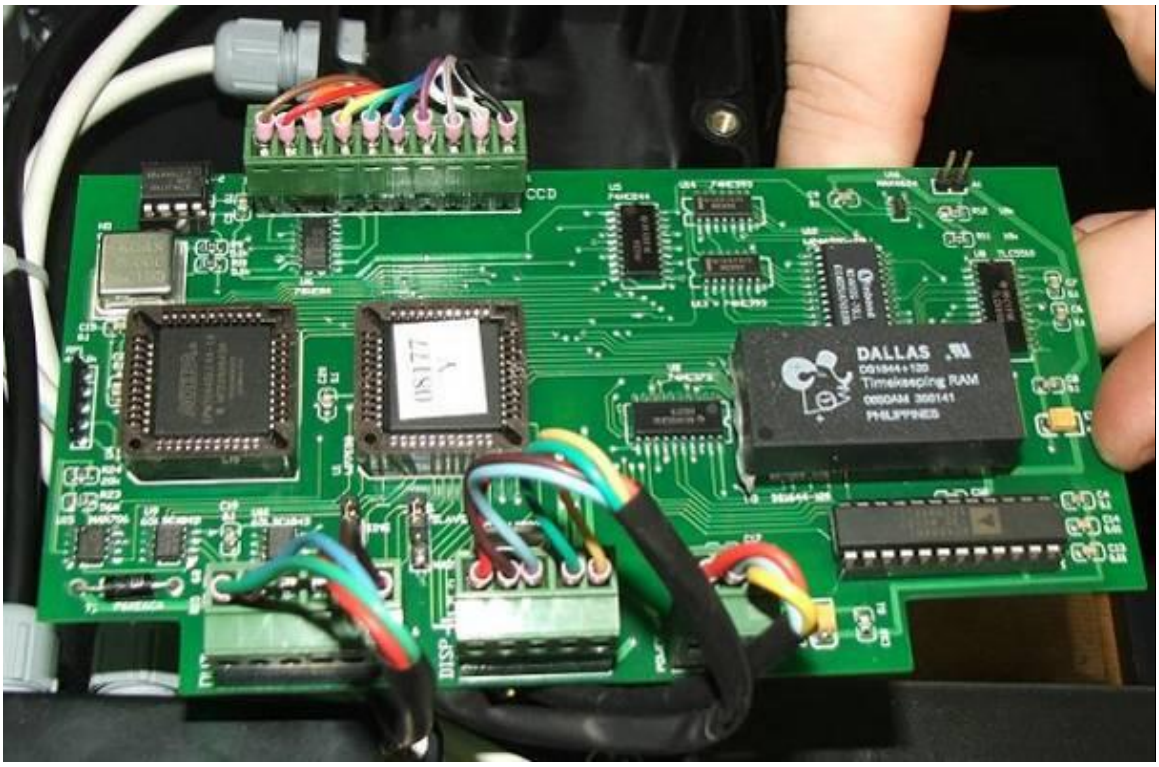


Figure 3: The axis board lifted out of enclosure

6. Use the “PLCC Chip Extractor Tool” *(Fig.4)* to carefully, insert the hooked ends into the slots on the outer edge of the “PLCC44 Chip Carrier” *(Fig 5 & 6)*, and gently lift the chip out of the carrier.

NOTE: Take care to not damage the chip by applying too much pressure along any of its edges.

Figure 4: PLCC Chip Extractor Tool

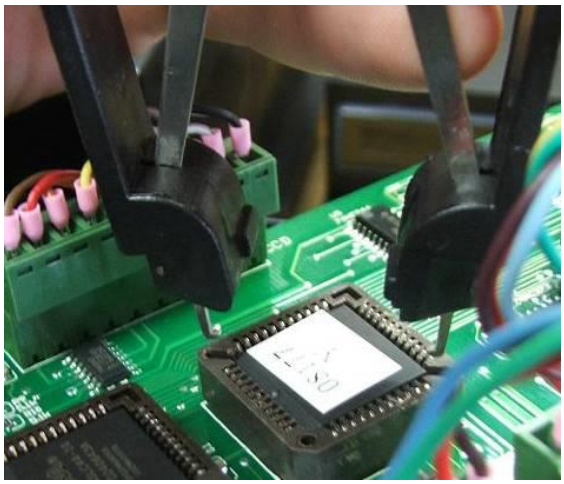


Figure 5: The extractor being inserted into the slots on the outer edge of the “Chip Carrier”

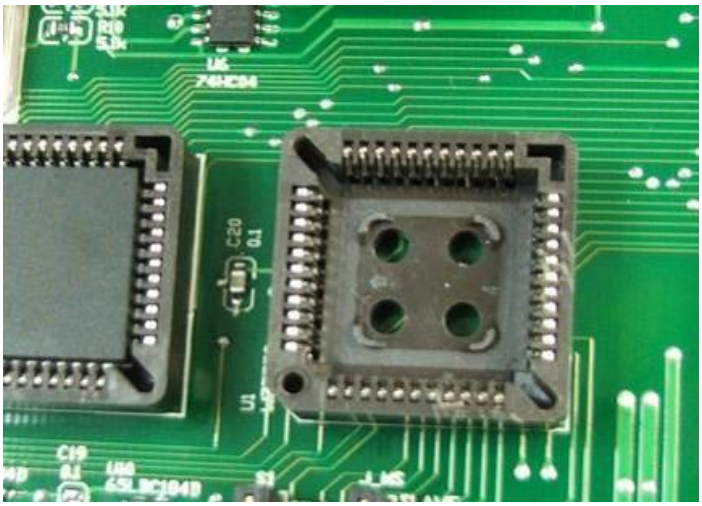


Figure 6: The PLCC44 Chip Carrier with chip removed

7. Use your fingers to gently ease the matching replacement chip onto the PLCC44 Chip Carrier. Be certain all pins are lined up before pushing the chip into the chip carrier.

8. Carefully reinsert the board back into the housing. Make sure that all wiring will be clear of the lid.

9. To assure a tight seal, the gasket on the lid must be properly aligned with the base. Use even pressure while securing the lid to the enclosure.

10. Reattach the cover once again taking care to slightly elevate the base to relieve any unnecessary stress on the unit or screws.

11. Finally, reattach the gap bracket to the cover.

Once all cover screws are secured, the Geopendulum unit should be ready for use.